CLAIMS

[Claim(s)]

[Claim 1] The manufacture method of a semiconductor device characterized by providing the following. The process which forms the slot for wiring for forming wiring in the insulator layer formed on the substrate. The process which makes a metal membrane deposit on the aforementioned insulator layer so that the aforementioned slot for wiring may be embedded. The process which forms the passive state film which demonstrates the operation which bars the electrolysis reaction of the metal membrane concerned in the front face of the metal membrane deposited on the aforementioned insulator layer. The process which carries out flattening of the irregularity of the front face of the aforementioned metal membrane which removed alternatively the immobility film on the heights which exist in the front face of the aforementioned metal membrane produced by the embedding of the aforementioned slot for wiring among the passive state films formed in the aforementioned metal membrane by mechanical polishing, removed the process which exposes the heights of the metal concerned on a front face, and the heights of the metal membrane which carried out [aforementioned] exposure by electrolytic polishing, and produced by the embedding of the aforementioned slot for wiring.

[Claim 2] the electrolysis compound polish which compounded electrolytic polishing and mechanical polishing for the excessive metal membrane to which the aforementioned front face exists on the aforementioned insulator layer of the metal membrane by which flattening was carried out -- the manufacture method of a semiconductor device according to claim 1 of having further the process which removes and forms the aforementioned wiring

[Claim 3] The aforementioned electrolysis compound polish is the manufacture method of a semiconductor device according to claim 2 of compounding electrolytic polishing and chemical machinery polish.

[Claim 4] The manufacture method of a semiconductor device according to claim 2 characterized by providing the following. After forming the aforementioned slot for wiring, the barrier film which consists of a conductive material for preventing the diffusion to the aforementioned insulator layer of the aforementioned metal membrane so that the aforementioned insulator layer top and aforementioned Mizouchi may be covered forms. The process remove until the aforementioned barrier film exposes the excessive metal membrane which exists on the aforementioned insulator layer to a front face by the aforementioned electrolysis compound polish, after carrying out flattening in the heights of the metal membrane which carried out [aforementioned] exposure. The process removed by the aforementioned electrolysis compound polish until the aforementioned insulator layer exposes to a front face the excessive barrier film which exists on the aforementioned insulator layer.

[Claim 5] Make the electrolytic solution intervene between the polished surface of the abrasive tools which have conductivity, and the aforementioned passive state film, use the aforementioned metal membrane and a barrier film as an anode plate, and the aforementioned abrasive tools are used as cathode. Impress voltage between the aforementioned metal membrane and a barrier film, and the aforementioned abrasive tools, and the aforementioned abrasive tools are moved to it relatively [front face / of the aforementioned passive state film]. The manufacture method of a semiconductor device according to claim 4 of making the heights of the aforementioned metal membrane exposed from the passive state film which removed alternatively the passive state film formed in the heights of the aforementioned metal membrane, and was removed by the aforementioned selection target eluted by the electrolytic action of the aforementioned electrolytic solution.

[Claim 6] The manufacture method of a semiconductor device according to claim 5 of making the polar-zone material to which voltage was impressed between the aforementioned abrasive tools contacting or approaching the aforementioned metal membrane and a barrier film, energizing on the aforementioned metal membrane and the aforementioned barrier film, carrying out the monitoring of the current which flows from the aforementioned polar-zone material to the aforementioned abrasive tools via the aforementioned aforementioned metal membrane and the aforementioned barrier film, and managing advance of polish of the aforementioned metal membrane and a barrier film based on the size of the current value concerned.

[Claim 7] The manufacture method of a semiconductor device according to claim 5 of making the polar-zone material to which voltage was impressed between the aforementioned abrasive tools contacting or approaching the aforementioned metal membrane and a barrier film, energizing on the aforementioned metal membrane and the aforementioned barrier film, carrying out the monitoring of the size of the electric resistance generated between the aforementioned polar-zone material and the aforementioned abrasive tools, and managing advance of polish of the aforementioned metal membrane and a barrier film based on the electric resistance value concerned.

[Claim 8] The manufacture method of a semiconductor device according to claim 5 of making the chemical-polishing agent containing a polish abrasive grain intervening between the polished surface of the aforementioned abrasive tools, and the aforementioned passive state film, and removing the aforementioned passive state film alternatively.

[Claim 9] each material which constitutes the aforementioned metal membrane and the aforementioned barrier film -- receiving -- a different chemical-polishing agent with a respectively high polish rate -- using -- the above -- the manufacture method of a semiconductor device according to claim 5 of removing an excessive metal membrane and a barrier film, respectively

[Claim 10] the above -- the voltage impressed between the aforementioned barrier film and the aforementioned abrasive tools at the process which removes an excessive barrier film -- the above -- the manufacture method of the semiconductor device according to claim 5 made lower than the voltage impressed between the aforementioned metal membranes in a process and the aforementioned abrasive tools which remove an excessive metal membrane

[Claim 11] The process which the process which forms the aforementioned slot for wiring has the process which forms the contact hole for connecting the impurity-diffusion layer or the wiring formed in the lower layer of the aforementioned insulator layer, and the wiring formed on the insulator layer concerned, and embeds in a metal to the aforementioned slot for wiring with formation of the aforementioned slot for wiring is the manufacture method of a semiconductor device according to claim 2 of embedding a metal to the aforementioned contact hole with the aforementioned slot for wiring

[Claim 12] The manufacture method of the semiconductor device according to claim 11 which uses copper for the formation material of the aforementioned wiring, and embeds copper at the aforementioned slot for wiring, and a contact hole using an electroplating method.

[Claim 13] The manufacture method of a semiconductor device according to claim 4 of using either Ta, Ti, TaN and TiN for the formation material of the aforementioned barrier film.

[Claim 14] The aforementioned passive state film is the manufacture method of the semiconductor device according to claim 1 which consists of an oxide film which oxidized the front face of the aforementioned metal membrane.
[Claim 15] The manufacture method of the semiconductor device according to claim 14 which supplies an oxidizer to the front face of the aforementioned metal membrane, and forms the aforementioned oxide film.
[Claim 16] The aforementioned passive state film is the manufacture method of the semiconductor device according to claim 1 which forms the film which consists of material which demonstrates the operation which bars the electrolysis reaction of the metal which constitutes the aforementioned metal membrane on the front face of the aforementioned metal membrane.
[Claim 17] The aforementioned passive state film is the manufacture method of the semiconductor device according to claim 16 which forms in the front face of the aforementioned metal membrane either the **** water screen, an oil film, an antioxidizing film, the film that consists of a surfactant, the film which consists of a chelating agent and the film which consists of a silane coupling agent.
[Claim 18] For the aforementioned passive state film, electric resistance is higher than the aforementioned metal membrane, and a mechanical strength is the manufacture method of a semiconductor device given in the low claim 1.
[Claim 19] The abrasive tools which have a polished surface and have conductivity, and an abrasive-tools rotation maintenance means to rotate and hold the aforementioned abrasive tools focusing on the predetermined axis of rotation, The rotation maintenance means which holds a ground object and is rotated focusing on the predetermined axis of rotation, The move positioning means which carries out move positioning of the aforementioned abrasive tools at the target position of the direction which counters the aforementioned ground object, A relative-displacement means to make the polished surface-ed of the aforementioned ground object, and the polished surface of the aforementioned abrasive tools displaced relatively along with a predetermined flat surface, Polish equipment which has an electrolytic-solution supply means to supply the electrolytic solution on the polished surface-ed of the aforementioned ground object, and an electrolytic-current supply means to supply the electrolytic current which uses the polished surface-ed of the aforementioned ground object as an anode plate, and flows from the aforementioned polished surface-ed to the aforementioned abrasive tools through the aforementioned electrolytic solution by using the aforementioned abrasive tools as cathode.
[Claim 20] Polish equipment according to claim 19 which has further an abrasive material supply means to supply the chemical-polishing agent which contains a polish abrasive grain in the polished surface-ed of the aforementioned ground object.
[Claim 21] The aforementioned electrolytic-current supply means is polish equipment [equipped with the DC power supply which impress predetermined potential between an energization means for it to be arranged possible / contact to the polished surface-ed of the aforementioned ground object /, or possible / approach /, and to energize to the polished surface-ed concerned by using the polished surface-ed of the aforementioned ground object as an anode plate, and the aforementioned energization means and the aforementioned abrasive tools] according to claim 1.
[Claim 22] The aforementioned DC power supply are polish equipment according to claim 21 which outputs the voltage of the shape of a pulse of a predetermined period.
[Claim 23] It is polish equipment [equipped with the conductive electrode board which the aforementioned abrasive tools consist of a conductive wheel-like member, and the end side where the member concerned is annular constitutes the polished surface, and the aforementioned energization means is isolated with the abrasive tools concerned inside the aforementioned abrasive tools, is prepared in it, is held by the aforementioned rotation maintenance means, and rotates with the aforementioned abrasive tools] according to claim 21.
[Claim 24] The aforementioned electrode board is polish equipment [equipped with the scrub member which has the field which carries out the scrub of the polished surface-ed concerned to the side which counters the polished surface-ed of the aforementioned ground object] according to claim 23.
[Claim 25] The aforementioned scrub member is polish equipment according to claim 24 which supplies the electrolytic solution and/or the chemical-polishing agent which are formed from the material which can absorb the chemical-polishing agent containing the aforementioned electrolytic solution and a polish abrasive grain, and can be passed, and are supplied from the aforementioned electrode board side to the polished surface-ed of a ground object.
[Claim 26] The aforementioned abrasive tools are polish equipment according to claim 21 energized through the energization brush which is held by the conductive member connected with the aforementioned rotation maintenance means, and contacts the aforementioned conductive member which carries out rotation.
[Claim 27] the electrolyzed metal with which the aforementioned polar-zone material was formed in the polished surface-ed of the aforementioned ground object -- receiving -- ** -- the polish equipment according to claim 23 which consists of a metal
[Claim 28] Polish equipment according to claim 19 further equipped with a current detection means to detect the value of the electrolytic current which flows from the polished surface-ed of the aforementioned ground object to the aforementioned abrasive tools.
[Claim 29] Polish equipment [equipped with a resistance detection means to detect the electric resistance between the aforementioned polar-zone material and the aforementioned abrasive tools which went via the polished surface-ed of the aforementioned ground object] according to claim 23.
[Claim 30] Polish equipment according to claim 29 which has further the control means which control the position of the opposite direction of the aforementioned abrasive tools and the aforementioned ground object based on the detecting signal of the aforementioned current detection means so that the value of the aforementioned electrolytic current becomes fixed.
[Claim 31] It has the abrasive tools which have the polished surface which contacts while rotating all over the polished surface-ed of a ground object. It is polish equipment which is contacted making the aforementioned polished surface rotate the aforementioned ground object, and carries out flattening polish. Have an electrolytic-solution supply means to supply the electrolytic solution on the aforementioned polished surface, and the aforementioned polished surface is equipped with the anode plate electrode and cathode electrode of the aforementioned ground object which can be energized to a polished surface-ed. Polish equipment which carries out flattening polish of the polished surface-ed of the aforementioned ground object by electrolysis compound polish which compounded electrolytic polishing by the aforementioned electrolytic solution, and mechanical polishing by the aforementioned polished surface.
[Claim 32] Polish equipment according to claim 31 which carries out flattening polish of the polished surface-ed of the aforementioned ground object by electrolysis compound polish which has further an abrasive material supply means to supply the chemical-polishing agent which contains a polish abrasive grain in the aforementioned polished surface, and compounded the chemical machinery polish by electrolytic polishing by the aforementioned electrolytic solution, the aforementioned polished surface, and the aforementioned abrasive material.
[Claim 33] Make the electrolytic solution intervene, force the polished surface of conductive abrasive tools, and the front face of the ground object with which the metal membrane was formed in the front face or the inner layer at least, use the aforementioned abrasive tools as cathode, and the front face of the aforementioned ground object is used as an anode plate. The electrolytic current which flows from the front face of the aforementioned ground object through the aforementioned electrolytic solution to the aforementioned abrasive tools is supplied. The polish method which carries out flattening of the metal membrane formed in the aforementioned ground object of the electrolysis compound polish which was made displaced relatively along with a predetermined flat surface, rotating both the aforementioned abrasive tools and the aforementioned ground object, and compounded the aforementioned electrolytic-solution **** electrolytic polishing and mechanical polishing by the aforementioned polished surface.

[Claim 34] The polish method according to claim 33 which carries out flattening of the metal membrane formed in the aforementioned ground object of the electrolysis compound polish which the chemical-polishing agent which contains a polish abrasive grain with the aforementioned electrolytic solution was made to intervene between the aforementioned polished surface and the front face of the aforementioned ground object, and compounded the chemical machinery polish by electrolytic polishing by the aforementioned electrolytic solution, the aforementioned polished surface, and the aforementioned abrasive material.
[Claim 35] The polish method according to claim 33 of the laminating of two or more films which become the aforementioned ground object from a different material being carried out, carrying out the monitoring of the electrolytic current which flows from the front face of the aforementioned ground object to the aforementioned abrasive tools through the aforementioned electrolytic solution which changes with the differences in the electrical property of the material of each aforementioned film, and managing advance of polish based on the size of the electrolytic current concerned.
[Claim 36] The polish method according to claim 33 which impresses the voltage of the shape of a pulse of a predetermined period between the aforementioned abrasive tools and the front face of the aforementioned ground object, and supplies the aforementioned electrolytic current to it.

[Claim 37] The polish method according to claim 33 which is made to approach or contact the front face of the aforementioned ground object with which polar-zone material was supplied to the aforementioned electrolytic solution, and is energized to the front face of the aforementioned ground object.
[Claim 38] The polish method according to claim 37 energized to the metal membrane formed in the aforementioned ground object while rotating the aforementioned polar-zone material with the aforementioned abrasive tools and you made it displaced relatively to the aforementioned ground object.
[Claim 39] The polish method according to claim 37 of managing advance of polish of the aforementioned ground object based on the size of the electric resistance between the aforementioned polar-zone material and the aforementioned abrasive tools which went via the front face of the aforementioned ground object.
[Claim 40] The polish method according to claim 34 of just electrifying the polish abrasive grain contained in the aforementioned abrasive material.
[Claim 41] The polish method characterized by providing the following. The process which forms the passive state film which demonstrates the operation which bars the electrolysis reaction of the metal membrane concerned in the front face of the metal membrane formed in the ground object. The process which the electrolytic solution is made to intervene between the polished surface of conductive abrasive tools, and the aforementioned metal membrane, and forces a polished surface and a metal membrane concerned, and impresses predetermined voltage in between with the aforementioned abrasive tools and the aforementioned metal membrane. The process which removes alternatively the passive state film on the heights which the polished surface of the aforementioned abrasive tools and the metal membrane of the aforementioned ground object were made displaced relatively along with a predetermined flat surface, and were projected to the polished surface of the aforementioned abrasive tools among the aforementioned metal membranes by mechanical polishing of the aforementioned abrasive tools. The process which removes the heights of the metal membrane which the aforementioned passive state film was removed and was exposed to the front face by the electrolytic-polishing operation by the aforementioned electrolytic solution, and carries out flattening of the aforementioned metal membrane.
[Claim 42] The polish method according to claim 41 that make the chemical-polishing agent which contains a polish abrasive grain with the aforementioned electrolytic solution intervene between the aforementioned polished surface and the aforementioned metal membrane, and the chemical machinery polish by the aforementioned polished surface and the aforementioned polish abrasive grain removes the aforementioned passive state film alternatively.
[Claim 43] The aforementioned passive state film is the polish method according to claim 41 which consists of an oxide film which oxidized the front face of the aforementioned metal membrane.
[Claim 44] The aforementioned passive state film is the polish method according to claim 41 which forms the film which consists of material which demonstrates the operation which bars the electrolysis reaction of the metal which constitutes the aforementioned metal membrane on the front face of the aforementioned metal membrane.
[Claim 45] The aforementioned passive state film is the polish method according to claim 41 that electric resistance is high and a mechanical strength is lower than the aforementioned metal membrane.
[Claim 46] The polish method according to claim 41 which an electrode member is made to approach or contact the front face of the aforementioned metal membrane, and is energized to the aforementioned metal membrane.
[Claim 47] The polish method according to claim 46 of managing advance of polish based on the size of the electric resistance between the aforementioned electrode member and the aforementioned abrasive tools.
[Claim 48] The polish method according to claim 42 of just electrifying the polish abrasive grain contained in the aforementioned abrasive material.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the polish equipment and the polish method of carrying out flattening of the concavo-convex field accompanying the multilayer-interconnection structure of a semiconductor device, and the manufacture method of a semiconductor device with multilayer-interconnection structure.
[0002]
[Description of the Prior Art] With high integration of a semiconductor device, and a miniaturization, reduction-izing of detailed-izing of wiring and a wiring pitch and multilayering of wiring are progressing, and the importance of the multilayer-interconnection technology in the manufacture process of a semiconductor device is increasing. On the other hand, although aluminum (aluminum) has been conventionally used abundantly as a wiring material of the semiconductor device of multilayer-interconnection structure, in order to suppress the propagation delay of a signal in the design rule below the latest 0.25-micrometer rule, development of the wiring process which replaced the wiring material with copper (Cu) from aluminum (aluminum) is performed briskly. When Cu is used for wiring, there is a merit that it is compatible in low resistance and high electromigration resistance. In the process which used this Cu for wiring, a metal is embedded at the circuit pattern of the shape of a slot beforehand formed in the layer insulation film, for example, and it is CMP (Chemical Mechanical Polishing: chemical machinery polish). DAMASHIN which removes an excessive metal membrane and forms wiring by the method (damascene) The wiring process called method is leading. Since etching [of wiring] becomes unnecessary [this DAMASHIN method] and the upper layer insulation film will also become flat naturally further, it has the feature that a process can be simplified. Furthermore, not only wiring but a contact hole is opened as a slot at a layer insulation film, and it becomes reducible [a still larger wiring process] by the dual DAMASHIN (dual damascene) method which embeds wiring and a contact hole with a metal simultaneously.
[0003] Here, an example of the wiring formation process by the above-mentioned dual DAMASHIN method is explained with reference to drawing 32 - drawing 37 . In addition, the case where Cu is used as a wiring material is explained. First, as shown in drawing 32 , the layer insulation film 302 which consists of a silicon oxide is formed for example, by the reduced pressure CVD (Chemical Vapour Deposition) method on the substrate 301 which the impurity diffusion field which is not illustrated becomes from semiconductors, such as silicon currently formed suitably. Subsequently, as shown in drawing 33 , the slot 304 in which wiring of the predetermined pattern electrically connected with the impurity diffusion field of the contact hole 303 which leads to the impurity diffusion field of a substrate 301, and a substrate 301 is formed is formed using well-known photolithography technology and etching technology. Subsequently, as shown in drawing 34 , the barrier film 305 is formed in the front face of the layer insulation film 302 and a contact hole 303, and a slot 304. This barrier film 305 forms material, such as Ta, Ti, TaN, and TiN, by the well-known spatter. The barrier film 305 is formed in order to prevent that the material which constitutes wiring is spread in the layer insulation film 302. This is prevented, in order that especially Cu may have a large diffusion coefficient to a silicon oxide and a wiring material may tend to oxidize by Cu, case [whose layer insulation film 302 is / like a silicon oxide].
[0004] Subsequently, on the barrier film 305, as shown in drawing 35 , the Cu film 307 is formed so that the seed Cu film 306 may be formed by predetermined thickness by the well-known spatter, and may be shown subsequently to drawing 36 , and a contact hole 303 and a slot 304 may be embedded by Cu. The Cu film 307 is formed by plating, CVD, the spatter, etc. Subsequently, as shown in drawing 37 , flattening of the excessive Cu film 307 and the barrier film 305 on the layer insulation film 302 is removed and carried out by the CMP method. Wiring 308 and contact 309 are formed of this. A multilayer interconnection can be formed by repeating the above-mentioned process on wiring 308, and performing it.
[0005]
[Problem(s) to be Solved by the Invention] By the way, in the multilayer-interconnection formation process using the above-mentioned dual DAMASHIN method, in the process which removes the excessive Cu film 307 and the barrier film 305 by the CMP method, since removal performances with the layer insulation film 302, the Cu film 307, and the barrier film 305 differed, disadvantageous profit of being easy to generate dishing, erosion (web thinning), a recess, etc. existed in wiring 308. When the large wiring 308 of width of face like about 100 micrometers exists in the design rule of 0.18-micrometer rule, dishing is the phenomenon of the center section of the wiring concerned being removed superfluously and cratering it, and as shown in drawing 38 , since the cross section of wiring 308 runs short if this dishing occurs, it causes poor wiring resistance. When comparatively elastic copper and aluminum are used for a wiring material, it is easy to generate this dishing. As shown in drawing 39 , erosion is the phenomenon in which a portion with high pattern density which is formed in the range of 3000 micrometers by the density whose wiring with a width of face of 1.0 micrometers is 50% will be removed superfluously, and since the cross section of wiring runs short if erosion occurs, it causes poor wiring resistance. As shown in drawing 40 , wiring 308 becomes low on the boundary of the layer insulation film 302 and wiring 308, a recess is the phenomenon which can do a level difference, and since the cross section of wiring runs short also in this case, it causes poor wiring resistance. Furthermore, it is necessary to remove efficiently the Cu film 307 and the barrier film 305, and it is required at the process which removes the excessive Cu film 307 and the barrier film 305 by the CMP method that the polish rate which is the amount of removal per unit time should become 500 or more nm/min. If it is necessary to enlarge the processing pressure force over a wafer and the processing pressure force is enlarged in order to earn this polish rate, as shown in drawing 41 , it will be easy to generate Scratch SC and the chemical damage CD on a wiring front face, they will become it, and it will especially be easy to generate with elastic Cu and elastic aluminum. For this reason, when it became the cause of the fault of opening of wiring, short-circuit, and poor wiring resistance and the processing pressure force was enlarged, disadvantageous profit that the yield of the above-mentioned dishing, erosion, and a recess also became large existed.
[0006] In case this invention carries out flattening of the metal membranes which are made in view of the above-mentioned problem, for example, have multilayer-interconnection structure, such as wiring of a semiconductor device, by polish, it can carry out flattening of the initial irregularity easily, and is excellent in the removal efficiency of an excessive metal membrane, and offers the polish equipment which can suppress generating of superfluous removal and the polish method of metal membranes, such as dishing and erosion, and the manufacture method of a semiconductor device.

[0007]
[Means for Solving the Problem] The abrasive tools which the polish equipment of this invention has a polished surface, and have conductivity, and an abrasive-tools rotation maintenance means to rotate and hold the aforementioned abrasive tools focusing on the predetermined axis of rotation, The rotation maintenance means which holds a ground object and is rotated focusing on the predetermined axis of rotation, The move positioning means which carries out move positioning of the aforementioned abrasive tools at the target position of the direction which counters the aforementioned ground object, A relative-displacement means to make the polished surface-ed of the aforementioned ground object, and the polished surface of the aforementioned abrasive tools displaced relatively along with a predetermined flat surface, It has an electrolytic-solution supply means to supply the electrolytic solution on the polished surface-ed of the aforementioned ground object, and an electrolytic-current supply means to supply the electrolytic current which uses the polished surface-ed of the aforementioned ground object as an anode plate, and flows from the aforementioned polished surface-ed to the aforementioned abrasive tools through the aforementioned electrolytic solution by using the aforementioned abrasive tools as cathode.
[0008] Moreover, it has the abrasive tools which have the polished surface which contacts while the polish equipment of this invention rotates all over the polished surface-ed of a ground object. It is polish equipment which is contacted making the aforementioned polished surface rotate the aforementioned ground object, and carries out flattening polish. Have an electrolytic-solution supply means to supply the electrolytic solution on the aforementioned polished surface, and the aforementioned polished surface is equipped with the anode plate electrode and cathode electrode of the aforementioned ground object which can be energized to a polished surface-ed. Flattening polish of the polished surface-ed of the aforementioned ground object is carried out by electrolysis compound polish which compounded electrolytic polishing by the aforementioned electrolytic solution, and mechanical polishing by the aforementioned polished surface.
[0009] The polish method of this invention makes the electrolytic solution intervene, forces the polished surface of conductive abrasive tools, and the front face of the ground object with which the metal membrane was formed in the front face or the inner layer at least, use the aforementioned abrasive tools as cathode, and the front face of the aforementioned ground object is used as an anode plate. The electrolytic current which flows from the front face of the aforementioned ground object through the aforementioned electrolytic solution to the aforementioned abrasive tools is supplied. You make it displaced relatively along with a predetermined flat surface, rotating both the aforementioned abrasive tools and the aforementioned ground object, and flattening of the metal membrane formed in the aforementioned ground object of the electrolysis compound polish which compounded the aforementioned electrolytic-solution **** electrolytic polishing and mechanical polishing by the aforementioned polished surface is carried out.
[0010] Moreover, the process which forms the passive state film which demonstrates the operation which bars the electrolysis reaction of the metal membrane concerned in the front face of a metal membrane on which the polish method of this invention was formed in the ground object, The process which the electrolytic solution is made to intervene between the polished surface of conductive abrasive tools, and the aforementioned metal membrane, and forces a polished surface and a metal membrane concerned, and impresses predetermined voltage in between with the aforementioned abrasive tools and the aforementioned metal membrane, The polished surface of the aforementioned abrasive tools and the metal membrane of the aforementioned ground object are made displaced relatively along with a predetermined flat surface. The process which removes alternatively the passive state film on the heights projected to the polished surface of the aforementioned abrasive tools among the aforementioned metal membranes by mechanical polishing of the aforementioned abrasive tools, It has the process which removes the heights of the metal membrane which the aforementioned passive state film was removed and was exposed to the front face by the electrolytic-polishing operation by the aforementioned electrolytic solution, and carries out flattening of the aforementioned metal membrane.
[0011] The manufacture method of the semiconductor device of this invention so that the process which forms the slot for wiring for forming wiring in the insulator layer formed on the substrate, and the aforementioned slot for wiring may be embedded The process which forms the passive state film which demonstrates the operation which bars the electrolysis reaction of the metal membrane concerned in the front face of the process which makes a metal membrane deposit on the aforementioned insulator layer, and the metal membrane deposited on the aforementioned insulator layer, The process which mechanical polishing removes [process] alternatively the immobility film on the heights which exist in the front face of the aforementioned metal membrane produced by the embedding of the aforementioned slot for wiring among the passive state films formed in the aforementioned metal membrane, and exposes the heights of the metal concerned on a front face, Electrolytic polishing removes the heights of the metal membrane which carried out [aforementioned] exposure, and it has the process which carries out flattening of the irregularity of the front face of the aforementioned metal membrane produced by the embedding of the aforementioned slot for wiring.
[0012] moreover, the electrolysis compound polish which compounded electrolytic polishing and mechanical polishing for the excessive metal membrane to which the manufacture method of the semiconductor device of this invention exists on the aforementioned insulator layer of the metal membrane to which flattening of the aforementioned front face was carried out -- it removes and has further the process which forms the aforementioned wiring
[0013] By the manufacture method of the semiconductor device of this invention, a passive state film is formed in the metal membrane which has irregularity in a front face, and the heights of a metal membrane are exposed to a front face by removing a passive state film mechanically. The heights of this metal membrane are alternatively eluted by the electrolytic action by the electrolytic solution by using the remaining passive state film as a mask. Consequently, flattening of the initial irregularity of a metal membrane is carried out. Moreover, in case the metal membrane to which flattening of the initial irregularity was carried out is removed by electrolysis compound polish at high efficiency, for example, wiring is formed, the excessive metal membrane which exists on an insulator layer is removed by high efficiency. If an excessive metal membrane is removed and an insulator layer is exposed, the electrolytic action of the portion will stop automatically and the metal membrane embedded in the slot for wiring formed in the insulator layer will not be removed superfluously.
[0014]
[Embodiments of the Invention] Hereafter, the form of operation of this invention is explained with reference to a drawing.
The block diagram 1 of polish equipment is drawing showing the composition of the polish equipment concerning 1 operation gestalt of this invention. Drawing 2 is the important section enlarged view of the processing head section of the polish equipment shown in drawing 1 . The polish equipment 1 shown in drawing 1 is equipped with the processing head section 2, the electrolysis power supply 61, the controller 55 that has the function which controls the polish equipment 1 whole, the slurry feeder 71, and the electrolytic-solution feeder 81. In addition, although not illustrated, polish equipment 1 is installed in a clean room, and the taking-out close port which carries out taking-out close [of the wafer cassette which held the wafer as a ground object] is prepared in the clean room concerned. Furthermore, the wafer carrier robot which delivers a wafer between the wafer cassettes and the polish equipment 1 which were carried in in the clean room through this taking-out close port is installed between a taking-out close port and polish equipment 1.
[0015] The processing head section 2 holds abrasive tools 3, makes it rotate, and is equipped with the abrasive-tools attaching part 11 holding abrasive tools 3, the Z-axis positioning mechanism section 31 which positions the abrasive-tools attaching part 11 to the target position of Z shaft orientations, and the X-axis move mechanism section 41 which is made to hold and rotate the wafer W as a ground object, and moves to X shaft orientations. In addition, the abrasive-tools attaching part 11 corresponds to one example of the abrasive-tools rotation maintenance means of this invention, the X-axis move mechanism section 41 corresponds to one example of the rotation maintenance means of this

invention, and a relative-displacement means, and the Z-axis positioning mechanism section 31 corresponds to one example of the move positioning means of this invention.

[0016] The Z-axis positioning mechanism section 31 is connected with the Z-axis servo motor 18 fixed to the column which is not illustrated, and the supporting structure 12 and the main shaft motor 13, and has the Z-axis slider 16 with which the screw section screwed in ball screw shaft 18a connected to the Z-axis servo motor 18 was formed, and the guide rail 17 installed in the column which holds the Z-axis slider 16 free [movement to Z shaft orientations], and which is not illustrated.

[0017] From the Z-axis driver 52 connected to the Z-axis servo motor 18, drive current is supplied and the rotation drive of the Z-axis servo motor 18 is carried out. Ball screw shaft 18a is prepared along the direction of Z shaft orientations, an end is connected to the Z-axis servo motor 18, and the other end is held free [rotation] by the attachment component prepared in the column which the above does not illustrate. Thereby, the Z-axis positioning mechanism section 31 carries out move positioning of the abrasive tools 3 held at the abrasive-tools attaching part 11 by the drive of the Z-axis servo motor 18 in the arbitrary positions of Z shaft orientations. Positioning accuracy of the Z-axis positioning mechanism section 31 is made into the resolution of about 0.1 micrometers.

[0018] The wafer table 42 on which the X-axis move mechanism 41 acts as the tea king of the wafer W, The supporting structure 45 held free rotation of the wafer table 42] and the drive motor 44 which supplies the driving force which rotates the wafer table 42, The belt 46 which connects a drive motor 44 and the axis of rotation of the supporting structure 45, The processing pan 47 prepared in the supporting structure 45, and the X-axis slider 48 with which a drive motor 44 and the supporting structure 45 were installed, It has the X-axis servo motor 49 by which the pedestal was carried out to the stand which is not illustrated, ball screw shaft 49a connected to the X-axis servo motor 49, and movable member 49b in which the screw section which connects with the X-axis slider 48 and is screwed in ball screw shaft 49a was formed.

[0019] The wafer table 42 adsorbs Wafer W for example, by the vacuum adsorption means. The processing pan 47 is formed in order to collect the used electrolytic solution and liquids, such as a slurry. A drive motor 44 can be driven by supplying drive current from the table driver 53, and the wafer table 42 can be rotated at a predetermined rotational frequency by controlling this drive current. By the drive current supplied from the X-axis driver 54 connected to the X-axis servo motor 49, the X-axis servo motor 49 carries out a rotation drive, and the X-axis slider 48 drives it to X shaft orientations through ball screw shaft 49a and movable member 49b. At this time, the speed control of X shaft orientations of the wafer table 42 becomes possible by controlling the drive current supplied to the X-axis servo motor 49.

[0020] Drawing 2 is drawing showing an example of the internal structure of the abrasive-tools attaching part 11. The abrasive-tools attaching part 11 is equipped with abrasive tools 3, the flange material 4 holding abrasive tools 3, the supporting structure 12 held free [rotation of the flange material 4], the main shaft motor 13 which is connected with main shaft 12a held at the supporting structure 12, and is made to rotate the main shaft 12a concerned, and the cylinder equipment 14 formed on the main shaft motor 13.

[0021] The main shaft motor 13 consists of a direct drive motor, and Rota which this direct drive motor does not illustrate is connected with main shaft 12a held at the supporting structure 12. Moreover, the main shaft motor 13 has the breakthrough by which piston rod 14b of cylinder equipment 14 is inserted in a core. The main shaft motor 13 is driven by the drive current supplied from the main shaft driver 51.

[0022] The supporting structure 12 is equipped with the pneumatic bearing, and holds main shaft 12a free [rotation] by this pneumatic bearing. Main shaft 12a of the supporting structure 12 also has the breakthrough by which piston rod 14b of cylinder equipment 14 is inserted in a core.

[0023] The flange material 4 is formed from the metallic material, it connected with main shaft 12a of the supporting structure 12, the bottom was equipped with opening 4a, and abrasive tools 3 have fixed to soffit side 4b. The upper-limit side 4c side of the flange material 4 is connected with main shaft 12a held at the supporting structure 12, and also rotates the flange material 4 by rotation of main shaft 12a. the conductive energization by which upper-limit side 4c of the flange material 4 was prepared in the side of the main shaft motor 13 and the supporting structure 12 -- it is in contact with the energization brush 27 fixed to the member 28, and the energization brush 27 and the flange material 4 are connected electrically

[0024] It is fixed on the case of the main shaft motor 13, cylinder equipment 14 contains piston 14a, and piston 14a drives it to one sense of the arrows A1 and A2 by the pneumatic pressure supplied for example, in cylinder equipment 14. Piston rod 14b is connected with this piston 14a, and piston rod 14b passed along the center of the main shaft motor 13 and the supporting structure 12, and has projected from opening 4a of the flange material 4. the nose of cam of piston rod 14b -- press -- a member 21 connects -- having -- **** -- this press -- the member 21 is connected in the predetermined range to piston rod 14b by the connection mechanism in which posture change is possible press -- the contact of a member 21 is attained at the periphery section of opening 22a of the electric insulating plate 22 arranged in the position which counters, and it presses an electric insulating plate 22 by the drive to the arrow A 2-way of piston rod 14b

[0025] The breakthrough is formed in the core of piston rod 14b of cylinder equipment 14, the energization shaft 20 is inserted into a breakthrough, and it is fixed to piston rod 14b. up to the rotary joint 15 which the energization shaft 20 is formed from a conductive material, and the upper-limit side penetrated piston 14a of cylinder equipment 14, and was prepared on cylinder equipment 14 -- being extended -- **** -- a soffit side -- piston rod 14b and press -- the member 21 was penetrated, even the electrode board 23 is extended, and it connects with the electrode board 23

[0026] The breakthrough is formed in the core and the energization shaft 20 serves as a supply nozzle with which this breakthrough supplies a chemical-polishing agent (slurry) and the electrolytic solution on Wafer W. Moreover, the energization shaft 20 has played the role which connects a rotary joint 15 and the electrode board 23 electrically.

[0027] The rotary joint 15 connected to the upper-limit section of the energization shaft 20 is electrically connected with the plus pole of the electrolysis electrode 61, and this rotary joint 15 maintains the energization to the energization shaft 20, even if the energization shaft 20 rotates. That is, even if the energization shaft 20 rotates, the potential of plus is impressed from the electrolysis electrode 61 by the rotary joint 15.

[0028] the metal membrane which the electrode board 23 connected to the soffit section of the energization shaft 20 consists of a metallic material, and is especially formed in Wafer W -- ** -- it is formed with the metal an upper surface side holds the electrode board 23 to an electric insulating plate 22 -- having -- **** -- the periphery section of the electrode board 23 -- an electric insulating plate 22 -- fitting in -- **** -- an undersurface side -- a scrub -- the member 24 is stuck

[0029] the bottom view in which drawing 3 (a) shows an example of the structure of the electrode board 23 here -- it is -- drawing 3 (b) -- the electrode board 23, and the energization shaft 20 and a scrub -- it is the cross section showing physical relationship with a member 24 and insulating member 4 As shown in drawing 3 (a), circular opening 23a is prepared in the center section of the electrode board 23, and two or more slot 23b extended to radial [of the electrode board 23] focusing on this opening 23a at a radial is formed. Moreover, as shown in drawing 3 (b), fitting fixing of the soffit section of the energization shaft 20 is carried out at opening 23a of the electrode board 23. the slurry and the electrolytic solution which are supplied by considering as such composition through supply nozzle 20a formed in the core of the energization shaft 20 -- slot 23b -- leading -- a scrub -- it is spread all over a member 24 namely, the electrode board 23, and the energization shaft 20 and a scrub -- supply nozzle 20a by which a slurry and the electrolytic solution were formed in the core of the energization shaft 20 while a member 24 and insulating member 4 rotated -- leading -- a scrub -- if the top side of a member 24 is supplied -- a scrub -- a slurry and the electrolytic solution spread in the whole top side of a member 24 in addition, a scrub -- supply nozzle 20a of a member 24 and the energization shaft 20 corresponds to one example of the abrasive material supply means of this invention, and an electrolytic-solution supply means Moreover, the electrode board 23, the energization shaft 20, and the rotary joint 15 correspond to one example of the energization means of this invention.

[0030] the scrub stuck on the inferior surface of tongue of the electrode board 23 -- a member 24 absorbs the electrolytic solution and a slurry, and is formed from the material which can make a bottom side pass these from a top side moreover, this scrub -- a member 24 is formed from the material of the shape of a soft brush, sponge-like material, porosity-like material, etc. so that the field which counters Wafer W may be the field which contacts Wafer W and carries out the scrub of the wafer W and a wafer W front face may not be made to generate a scratch etc. For example, the porosity object which consists of resins, such as a urethane resin, melamine resin, an epoxy resin, and a polyvinyl acetal (PVA), is mentioned.

[0031] two or more connection with this electric insulating plate 22 the electric insulating plate 22 is formed from insulating materials, such as ceramics, and cylindrical -- the member 26 connects with main shaft 12a of the supporting structure 12 connection -- the member 26 is arranged at equal intervals from the medial axis of an electric insulating plate 22 in the predetermined radius position, and is held free movement] to main shaft 12a of the supporting structure 12 For this reason, an electric insulating plate 22 is movable to the shaft orientations of main shaft 12a. moreover -- between an electric insulating plate 22 and main shaft 12a -- each connection -- corresponding to the member 26, it connects by the elastic member 25 which consists of a coil spring

[0032] if high-pressure air is supplied to cylinder equipment 14 and piston rod 14b is dropped to the sense of an arrow A2 by enabling movement of an electric insulating plate 22 to main shaft 12a of the supporting structure 12, and considering as the composition which connects an electric insulating plate 22 and main shaft 12a by the elastic member 25 -- press -- a member 21 -- the stability of an elastic member 25 -- opposing -- an electric insulating plate 22 -- caudad -- depressing -- this -- a scrub -- a member 24 also descends if supply of the high-pressure air from this state to cylinder equipment 14 is stopped -- the stability of an elastic member 25 -- an electric insulating plate 22 -- going up -- this -- a scrub -- a member 24 also goes up

[0033] Abrasive tools 3 have fixed to annular soffit side 4b of the flange material 4. These abrasive tools 3 are formed in the shape of a wheel, and equip the soffit side with annular polished surface 3a. Abrasive tools 3 have conductivity and form it with the material of elasticity nature comparatively preferably. for example, the carbon in which the binder matrix (binder) itself has conductivity -- or it can form from the porosity object which consists of resins, such as a urethane resin containing conductive material, such as a sintered copper and a metal compound, melamine resin, an epoxy resin, and a polyvinyl acetal (PVA) The direct file of the abrasive tools 3 is carried out to the flange material 4 which has conductivity, and they are energized from the energization brush 27 in contact with the flange material 4. namely, the conductive energization prepared in the side of the main shaft motor 13 and the supporting structure 12 -- a member 28 is electrically connected with the minus pole of the electrolysis power supply 61 -- having -- energization -- the energization brush 27 formed in the member 28 -- upper-limit side 4c of the flange material 4 -- contacting -- **** -- thereby -- abrasive tools 3 -- the electrolysis power supply 61 and energization -- it connects electrically through a member 28, the energization brush 27, and the flange material 4

[0034] As abrasive tools 3 are shown in drawing 4 , polished surface 3a inclines at the minute angle to a medial axis. Moreover, main shaft 12a of an attachment component 12 as well as the inclination of polished surface 3a inclines to the principal plane of Wafer W. For example, the minute inclination of main shaft 12a can be made by adjusting the installation posture to the Z-axis slider 16 of an attachment component 12. Thus, when the medial axis of abrasive tools 3 inclines at the minute angle to the principal plane of Wafer W and polished surface 3a of abrasive tools 3 is forced on Wafer W by the predetermined processing pressure force F, the efficiency operation field S to the wafer W of polished surface 3a turns into a field of the shape of a straight line extended to radial [of abrasive tools 3], as shown in drawing 4 . For this reason, in case Wafer W is moved to X shaft orientations to abrasive tools 3 and polish descent is performed, while moving to drawing 5 (b) from the state of drawing 5 (a), the area of the efficiency operation field S serves as abbreviation regularity. With the polish equipment 1 concerning this operation form, make a part of polished surface 3a of abrasive tools 3 act on the front face of Wafer W partially, the front face of Wafer W is made to scan the effective operation field S uniformly, and the whole surface of Wafer W is ground uniformly.

[0035] The electrolysis power supply 61 is equipment which impresses predetermined voltage between above-mentioned rotary joints 15 and energization brushes 12. impressing voltage between a rotary joint 15 and the energization brush 12 -- abrasive tools 3 and a scrub -- the potential difference occurs between members 24 Preferably, voltage is outputted in the shape of a pulse a fixed period, for example, not the constant voltage power supply that always outputs fixed voltage but the DC power supply which built in the switching regulator circuit are used for the electrolysis power supply 61. Specifically, pulse-like voltage is outputted a fixed period and the power supply which can be changed suitably is used for pulse width. As an example, output voltage used what 2-3A, and pulse width can change [DC150V and a peak output current] into 1, 2, 5, 10, or 20 or 50 microseconds. It considers as the voltage output of the shape of a pulse with the above short width of face for making very small the electrolysis elution volume per one pulse. That is, the spark discharge by sudden change of the electric resistance started when electric discharge, air bubbles, particle, etc. by the sudden change of the distance between electrodes seen when it contacts, the irregularity of the metal membrane formed in the front face of Wafer W, intervene etc. is effective in order to carry out huge elution of the shape of a sudden crater of a metal membrane to prevention or the continuation of a small thing suppressed as much as possible. Moreover, as compared with the output current, since output voltage is comparatively high, a certain amount of margin can be set as a setup of the distance between electrodes. That is, even if the distance between electrodes changes somewhat, since output voltage is high, current-value change is small.

[0036] The electrolysis power supply 61 is equipped with the ammeter 62 as a current detection means of this invention, in order that this ammeter 62 may carry out the monitor of the electrolytic current which flows to the electrolysis power supply 61, it is prepared, and 62s of current-value signals which carried out the monitor is outputted to contra 55. Moreover, the electrolysis power supply 61 is equipped with the ohm-meter 63 as a resistance detection means of this invention, in order that this ohm-meter 63 may carry out the monitoring of the electric resistance between the abrasive tools 3 and the electrode boards 23 which went via the front face of Wafer W based on the current which flows to the electrolysis power supply 61, it is prepared, and it outputs 63s of electric resistance value signals which carried out monitoring to contra 55.

[0037] The slurry feeder 71 supplies a slurry to supply nozzle 20a of the above-mentioned energization shaft 20. The thing which made the solution which has as a slurry the oxidizing power which used a hydrogen peroxide, iron nitrate, the potassium iodate, etc. as the base as an object for polish of a metal membrane contain an aluminum oxide (alumina), a cerium oxide, a silica, a germanium dioxide, etc. as a polish abrasive grain is used. Moreover, a polish abrasive grain is just beforehand electrified, in order to improve dispersibility and to hold a colloidal state.

[0038] The electrolytic-solution feeder 81 supplies the electrolytic solution EL to the processing head section 11. The electrolytic solution EL is a solution which consists of a solvent and a solute separated in ion. As this electrolytic solution, the solution which adjusted the reducing agent to the nitrate or the chloride system can be used.

[0039] A controller 55 has the function which controls the whole polish equipment 1. specifically Output 51s of control signals to the main shaft driver 51, and the rotational frequency of abrasive tools 3 is controlled. Output 52s of control signals to the Z-axis driver 52, and point to point control of Z shaft orientations of abrasive tools 3 is performed. 53s of control signals is outputted to the table driver 53, the rotational frequency of Wafer W is controlled, 54s of control signals is outputted to the X-axis driver 54, and speed control of X shaft orientations of Wafer W is performed. Moreover, a controller 55 controls operation of the electrolytic-solution feeder 81 and the slurry feeder 71, and controls the electrolytic solution EL to the processing head section 2, and supply operation of Slurry SL.

[0040] Moreover, a controller 55 can control the output voltage of the electrolysis power supply 61, the frequency of an output pulse, the width

of face of an output pulse, etc. Moreover, 62s of current-value signals and 63s of electric resistance value signals from the ammeter 62 and ohm-meter 63 of the electrolysis power supply 61 are inputted into a controller 55. A controller 55 can control operation of polish equipment 1 based on 62s of these current-value signals, and 63s of electric resistance value signals. By making 62s of current-value signals into a feedback signal, the Z-axis servo motor 18 controls, or operation of polish equipment 1 is controlled based on the value of the current value specified by 62s of current-value signals, and 63s of electric resistance value signals, and an electric resistance value to stop polish processing so that the electrolytic current obtained from 62s of current-value signals becomes specifically fixed.

[0041] An operator inputs various kinds of data, or the control panel 56 connected to the controller 55 displays 62s of current-value signals and 63s of electric resistance value signals which carried out monitoring.

[0042] Next, the case where the metal membrane formed in the wafer W front face in polish operation by the above-mentioned polish equipment 1 is ground is explained to an example. In addition, the case where the metal membrane which consists of copper is formed in the front face of Wafer W is explained. First, chucking of the wafer W is carried out to the wafer table 45, the wafer table 45 is driven, and Wafer W is rotated at a predetermined rotational frequency. Moreover, the wafer table 45 is moved to X shaft orientations, the abrasive tools 3 attached in the flange 4 are located in the upper predetermined position of Wafer W, and abrasive tools 3 are rotated at a predetermined rotational frequency. the electric insulating plate 22 connected with the flange 4 when abrasive tools 3 were rotated, the electrode board 23, and a scrub -- the rotation drive also of the member 24 is carried out moreover, a scrub -- the press which is pressing the member 24 -- a member 21, piston rod 14b, piston 14a, and the energization shaft 20 also rotate simultaneously

[0043] if Slurry SL and the electrolytic solution EL are supplied to supply nozzle 20a within the energization shaft 20, respectively from the slurry feeder 71 from this state, and the electrolytic-solution feeder 81 -- a scrub -- Slurry SL and the electrolytic solution EL are supplied from the whole surface of a member 24 Abrasive tools 3 are dropped to Z shaft orientations, polished surface 3a of abrasive tools 3 is contacted on the front face of Wafer W, and it is made to press by the predetermined processing pressure force. moreover, the electrolysis power supply 61 is started -- making -- the energization brush 27 -- leading -- the potential of the minus to abrasive tools 3 -- impressing -- a rotary joint 15 -- leading -- a scrub -- the potential of plus is impressed to a member 24

[0044] furthermore, high-pressure air is supplied to cylinder equipment 14, and piston rod 14b is descended in the direction of the arrow A2 of drawing 1 -- making -- a scrub -- the inferior surface of tongue of a member 24 is moved to the position which contacts or approaches Wafer W The wafer table 45 is moved to X shaft orientations by the predetermined rate pattern from this state, and polish processing of the whole surface of Wafer W is carried out uniformly.

[0045] It is the schematic diagram showing the state where drawing 6 dropped abrasive tools 3 to Z shaft orientations in polish equipment 1, and the front face of Wafer W was made to contact here, drawing 7 is an enlarged view in the circle C of drawing 6 , and drawing 8 is an enlarged view in the circle D of drawing 7 . it is shown in drawing 7 -- as -- a scrub -- by contacting directly the metal membrane MT formed in Wafer W through the electrolytic solution EL supplied on Wafer W, a member 24 is energized as an anode plate and energized as cathode by contacting directly the metal membrane MT in which abrasive tools 3 were also formed at Wafer W through the electrolytic solution EL supplied on Wafer W in addition, it is shown in drawing 7 -- as -- a metal membrane MT and a scrub -- gap deltab exists between members 24 Furthermore, as shown in drawing 8 , gap deltaw exists between a metal membrane MT and polished surface 3a of abrasive tools 3. it is shown in drawing 7 -- as -- an electric insulating plate 4 -- abrasive tools 3 and a scrub -- although it intervenes between members 24 (electrode board 23) -- the resistance R0 of an electric insulating plate 4 -- very much -- large -- therefore, a scrub -- current i0 which flows from a member 24 to abrasive tools 3 through an electric insulating plate 4 about 0 -- it is -- a scrub -- to abrasive tools 3, current does not flow through an electric insulating plate 4 from a member 24

[0046] for this reason, a scrub -- current i1 to which the current which flows to abrasive tools 3 flows from a member 24 to abrasive tools 3 via the resistance R1 in the direct electrolytic solution EL It branches to current i2 which flows in the current which flows [be / under / electrolytic-solution EL / passing / it] to abrasive tools 3 again out of the electrolytic solution EL via the metal membrane MT which consists of copper formed in the front face of Wafer W. If current i2 flows on the front face of a metal membrane MT, the copper which constitutes a metal membrane MT will be ionized by the electrolytic action of the electrolytic solution EL, and will be eluted in the electrolytic solution EL

[0047] here -- the resistance R1 in the electrolytic solution EL -- the scrub as an anode plate -- in proportion to the distance d of a member 24 and the abrasive tools 3 as cathode, it becomes extremely large For this reason, current i1 which flows to abrasive tools 3 via the resistance R1 in the direct electrolytic solution EL by making the distance between electrodes d larger enough than gap deltab and gap deltaw It becomes very small, current i2 becomes large, and a metal membrane MT will carry out the surface course of most electrolytic currents. For this reason, electrolysis elution of the copper which constitutes a metal membrane MT can be performed efficiently. Moreover, since the size of current i2 changes with the sizes of gap deltab and gap deltaw, as mentioned above, it can make current i2 regularity by performing position control of Z shaft orientations of abrasive tools 3, and adjusting the size of gap deltab and gap deltaw by the controller 55. Adjustment of the size of gap deltaw is possible by controlling the Z-axis servo motor 18 by making 62s of current-value signals into a feedback signal so that the electrolytic current obtained from 62s of current-value signals, i.e., current i2, may become fixed. Moreover, the positioning accuracy of Z shaft orientations of polish equipment 1 is fully as high as the resolution of 0.1 micrometers, in addition since it is always maintained uniformly, whenever the execution-[making main shaft 12a incline at a minute angle to the principal plane of Wafer W] touch area S controls the value of an electrolytic current uniformly, it is made as current density is always fixed, and can also make the electrolysis elution volume of a metal membrane regularity.

[0048] as mentioned above, the electrolytic action according the metal which constitutes the metal membrane MT formed in the wafer W which mentioned above the polish equipment 1 of the above-mentioned composition to the electrolytic solution EL -- it has the electrolytic-polishing function which carries out elution removal Furthermore, in addition to this electrolytic-polishing function, the polish equipment 1 of the above-mentioned composition is equipped also with the chemical machinery polish function of abrasive tools 3 and the usual CMP equipment by Slurry SL, and it can also perform grinding Wafer W by compound operation of these electrolytic-polishing function and chemical machinery polish (henceforth electrolysis compound polish). Moreover, the polish equipment 1 of the above-mentioned composition can also perform polish processing by compound operation with mechanical polish and the electrolytic-polishing function of polished surface 3a of abrasive tools 3, without using Slurry SL. Since the polish equipment 1 of the above-mentioned composition can grind a metal membrane by compound operation of electrolytic polishing and chemical machinery polish, it can remove a metal membrane in high efficiency far compared with the polish equipment only using chemical machinery polish or mechanical polishing. Since the high polish rate to a metal membrane is obtained, it becomes possible to suppress low the processing pressure force F over the wafer W of abrasive tools 3 compared with the polish equipment only using chemical machinery polish or mechanical polishing, and generating of dishing and erosion can be suppressed.

[0049] The case where it applies to the wiring formation process by the dual DAMASHIN method of the semiconductor device of multilayer-interconnection structure hereafter about the polish method using the electrolysis compound polish function of the polish equipment 1 concerning this operation gestalt is explained to an example.

[0050] < -- A HREF -- = -- " -- /-- Tokujitu/tjitemdrw -- . -- ipdl?N -- 0000 -- = -- 237 -- & -- N -- 0500 -- = -- one -- E_N -- /--; -- > -- < -- ? -- 88 -- > -- > -- eight -- /-- /-- /-- & -- N -- 0001 -- = -- 152 -- & -- N -- 0552 -- = -- nine -- & -- N -- 0553 -- = -- 000011 -- " -- TARGET -- = -- "tjitemdrw" -- > -- drawing 9 -- First, it is TEOS (tetraethylorthosilicate) considering the layer insulation film 102 which consists of a silicon oxide (SiO2) as for example, a source of a reaction on the wafer W with which the impurity diffusion field which is not illustrated is suitably formed, for example,

consists of semiconductors, such as silicon, as shown in drawing 10 . It uses and forms by the reduced pressure CVD (Chemical Vapour Deposition) method. Subsequently, as shown in drawing 11 , the slot 104 for wiring in which wiring of the predetermined pattern electrically connected with the impurity diffusion field of the contact hole 103 and Wafer W which lead to the impurity diffusion field of a wafer is formed is formed using well-known photolithography technology and etching technology, for example. In addition, the depth of the slot 104 for wiring is about 800nm.

[0051] Subsequently, as shown in drawing 12 , the barrier film 105 is formed in the front face of the layer insulation film 102 and a contact hole 103, and the slot 104 for wiring. This barrier film 305 is PVD (Physical Vapor Deposition) which used material, such as Ta, Ti, TaN, and TiN, for the sputtering system, the vacuum evaporation system, etc. By the method, it forms by about 15nm thickness. The barrier film 305 is formed in order to prevent that the material which constitutes wiring is spread in the layer insulation film 102, and in order to raise adhesion with the layer insulation film 102. This is prevented, in order that especially copper may have a large diffusion coefficient to a silicon oxide and a wiring material may tend to oxidize with copper, case [whose layer insulation film 102 is / like a silicon oxide]. The process to the above is the process PR 1 shown in drawing 9 .

[0052] Subsequently, as shown in drawing 13 , the seed film 106 which consists of the same material as wiring formation material, for example, copper, is formed by about 150nm thickness by the well-known spatter on the barrier film 105 (process PR 2). When copper is embedded in the slot for wiring, and a contact hole, the seed film 106 is formed in order to urge growth of a copper grain. Subsequently, as shown in drawing 14 , the metal membrane 107 which consists of copper is formed by about 2000nm thickness on the barrier film 105 so that a contact hole 103 and the slot 104 for wiring may be embedded. Preferably, although a metal membrane 107 is formed by electrolysis plating or the electroless deposition method, you may form it by CVD, the spatter, etc. In addition, the seed film 106 is united with a metal membrane 107 (process PR 3).

[0053] Here, drawing 15 is the enlarged view of the cross section of the semiconductor device in the middle of the manufacture process in which the metal membrane 107 was formed on the barrier film 105. As shown in drawing 15 , in the front face of a metal membrane 107, irregularity with a height of about 600nm has occurred for the embedding to a contact hole 103 and the slot 104 for wiring. Although the above process is performed in the same process as usual, it performs removal of the excessive metal membrane 107 which exists on the layer insulation film 102, and the barrier film 105 by the polish method of this invention not by chemical machinery polish but by electrolysis compound polish of above polish equipment 1. Moreover, by the polish method of this invention, in advance of the process by the above-mentioned electrolysis compound polish, as shown in drawing 16 , the passive state film 108 is formed in the front face of a metal membrane 107 (process PR 4). This passive state film 108 is a film which consists of material which demonstrates the operation which bars the electrolysis reaction of the metal (copper) which constitutes a metal membrane 107.

[0054] The formation method of the passive state film 108 applies an oxidizer to the front face of a metal membrane 107, and forms an oxide film in it. When the metal which constitutes a metal membrane 107 is copper, a copper oxide (CuO) serves as the passive state film 108. Moreover, it is also possible to form in the front face of a metal membrane 107 either for example, the **** water screen, an oil film, an antioxidizing film, the film that consists of a surfactant, the film which consists of a chelating agent and the film which consists of a silane coupling agent as other methods, and to consider as the passive state film 108. Although especially the kind of passive state film 108 is not limited, to a metal membrane 107, electric resistance is high and uses the thing of the property in which a mechanical strength is comparatively low and weak.

[0055] Next, by the polish method of this invention, only the passive state film 108 formed in the heights of a metal membrane 107 is removed alternatively (process PR 5). Above polish equipment 1 performs alternative removal of the passive state film 108. In addition, a slurry with the high polish rate to copper is used for the slurry SL to be used. For example, what contains the polish abrasive grain of an alumina, a silica, and a manganese system in the solution which used a hydrogen peroxide, iron nitrate, the potassium iodate, etc. as the base is used. first, the abrasive tools 3 which rotate while carrying out chucking of the wafer W to the wafer table 42 of polish equipment 1 and supplying the electrolytic solution EL and Slurry SL on Wafer W and a scrub -- drop a member 24 to Z shaft orientations, Wafer W is made to contact or approach, Wafer W is moved to X shaft orientations by the predetermined rate pattern, and polish processing is performed Moreover, a direct-current pulse voltage is impressed between abrasive tools 3 and the electrode board 23 by making a minus pole and the electrode board 23 into a plus pole at abrasive tools 3. In addition, you may supply Slurry SL on Wafer W by giving the function of the electrolytic solution SL to the solution used as the base of Slurry SL.

[0056] the scrub which is in the state of the above [drawing 17] here -- a member -- it is the conceptual diagram showing the polish process in the 24 neighborhood, and drawing 18 is the conceptual diagram showing the polish process in the abrasive-tools 3 neighborhood it is shown in drawing 17 -- as -- a scrub -- a member -- in the 24 neighborhood, Slurry SL and the electrolytic solution EL supply from slot 23b of the rotating electrode board 23 -- having -- Slurry SL and the electrolytic solution EL -- a scrub -- a member 24 -- passing -- a scrub -- it is supplied on Wafer W from the whole surface of a member 24 Elution of the copper which constitutes the metal membrane 107 to the inside of the electrolytic solution EL has the passive state film 108 formed on the metal membrane 107 in the state where it was suppressed in order not to receive the electrolytic action by the electrolytic solution EL. For this reason, the current value in which current hardly flowed to a metal membrane 107, but the above-mentioned ammeter 62 carried out the monitor has been stabilized low. Drawing 25 is a graph which shows an example of the current value which acted as the monitor with the ammeter 62 in the electrolysis compound polish process of this operation form. Near the starting position of current value shown in drawing 25 is in the above-mentioned state.

[0057] a scrub -- according to rotation of a member 24, it is contained in a mechanical removal operation or Slurry SL, for example, is mechanically removed from the passive state film 108 on the high portion of the passive state film 108, i.e., the heights of a metal membrane 107, by the mechanical removal operation of the polish abrasive grain PT which consists of an aluminum oxide On the other hand, as shown in drawing 18 , in the abrasive-tools 3 neighborhood, the passive state film 108 which exists in a metal membrane 108 by a mechanical removal operation of abrasive tools 3 or mechanical removal operation of the polish abrasive grain PT is removed from a high portion.

[0058] Thus, if the passive state film 108 formed on the heights of a metal membrane 107 is alternatively removed for example, as shown in drawing 19 , a metal membrane 107 will be exposed to a front face from the portion from which the passive state film 108 was removed alternatively.

[0059] If a metal membrane 107 is exposed to a front face, it will be alternatively eluted by the amount of [of the metal membrane 107 which is heights] outcrop (process PR 5): As an operation of the electrolytic solution EL at this time is shown in drawing 18 , the copper with which the heights of the metal membrane 107 which is the portion from which the passive state film 108 was removed constitute a metal membrane 107 is eluted in the electrolytic solution EL as copper-ion Cu+ by the electrolytic action. By this, it is the minus electron e in a metal membrane 107. - It flows and is this minus electron e. - Current i2 which flowed and described above from the front face of a metal membrane 107 to the electrode board 23 through the electrolytic solution EL as shown in drawing 17 It becomes.

[0060] As mentioned above, since electric resistance is low and current density of copper which constitutes a metal membrane 107 increases compared with the passive-state film 108, an intensive electrolytic action is received, elution starts alternatively, and material removal is accelerated. Moreover, in order to energize through the electrolytic solution EL, when the potential difference of the abrasive tools 3 as the metal membrane 107 and cathode as an anode plate is fixed, the current value to which the one where an electric resistance value is lower flows in between very much becomes [the distance between electrodes] short greatly. For this reason, if there is a difference (the distance

between electrodes is [the portion high in the heights of a metal membrane 107] shorter, and electric resistance is low) of the inter-electrode distance by the irregularity of the metal membrane 107 as cathode to the abrasive tools 3 as cathode, efficient flattening to which elution speed becomes large at high order will advance from the difference in current density. At this time, in drawing 25 , as shown in P1, the current value in which the above-mentioned ammeter 62 carried out the monitor begins to go up. Compared with mechanical flattening, as for the heights of a metal membrane 107, flattening is far carried out to high efficiency by such operation.

[0061] The front face of the metal membrane 107 which alternative electrolysis compound polish completed by it until flattening of the heights of a metal membrane 107 was carried out nearly completely by the above-mentioned operation turns into a compound side of the new field of the copper from which the heights of the passive-state film 108 which remains into the portion which was the crevice of a metal membrane 107, and a metal membrane 107 were removed, as shown in drawing 20 .

[0062] Then, as shown in drawing 21 , the electrolysis compound polish which the electrolytic action by the mechanical removal and the electrolytic solution EL which are performed on the front face of this metal membrane 107 by the polish abrasive grain PT in abrasive tools 3 and Slurry SL compounded advances (process PR 7). As the mechanical strength of the passive-state film 108 which remains at this time was mentioned above, when electrolysis compound polish of the passive-state film 108 is carried out compared with a copper new field for a low reason, it is mainly removed by the mechanical work, the copper front face in the bottom of it is exposed, and an electrolytic action increases in proportion to the area. When full removal of the passive-state film 108 is carried out, the surface area of the copper which constitutes a metal membrane 107 serves as the maximum. After the current value to which the current which could come, simultaneously acted as the monitor with the ammeter 62 went up from the position of P1 in drawing 25 goes up with removal of the passive-state film 108, when P2 from which a copper surface area serves as the maximum shows it, it turns into maximum. According to the process so far, flattening of the initial irregularity of the front face of a metal membrane 107 is completed.

[0063] Thus, since electrolysis compound polish of this operation form is the polish electrochemically aided with the polish rate, it can be ground by the low processing pressure force compared with the usual chemical machinery polish. Even if it compares this as simple mechanical polish, it is very advantageous in respect of reduction of a scratch, a level difference relief performance, dishing, reduction of erosion, etc. Furthermore, it is very advantageous, when mechanical strength uses for the layer insulation film 102 the low dielectric constant film of an organic system and porosity low dielectric constant insulator layer which are easy to be destroyed in the low usual chemical machinery polish, since it can grind by the low processing pressure force.

[0064] If electrolysis compound polish of the above-mentioned metal membrane 107 advances and the excessive metal membrane 107 is removed, as shown in drawing 22 , the barrier film 105 will be exposed (process P8). At this time, the current in which an ammeter 62 acts as a monitor takes maximum from the time of the passive-state film 108 on the metal membrane 107 shown by P2 of drawing 25 being removed altogether, and it takes the value of abbreviation regularity until the barrier film 105 shown by P3 of drawing 25 is exposed. If the barrier film 105 is exposed, when material, such as Ta, Ti, TaN, and TiN, is used, the current value which acted as the monitor with the ammeter 62 from the time of the electric resistance showing by P3 which exposure of the barrier film 105 of drawing 25 starts since it is large compared with copper will begin to fall, for example. In this state, it is in the state where the copper film for an ununiformity of a metal membrane 107 remains, and polish processing is stopped in this state. As shown in P4 of drawing 25 , a controller 55 judges that current value fell to the predetermined value, and a halt of this polish processing stops polish operation of polish equipment 1.

[0065] Subsequently, the barrier film 105 is removed (process PR 9). In the process which removes this barrier film 105, to the barrier film 105 formed to the metal membrane 107 which consists of above-mentioned copper from material, such as not the slurry SL with a high polish rate but Ta, TaN, Ti, TiN, etc., a polish rate is high and uses the slurry SL with a low polish rate to a metal membrane 107. That is, the selection ratio of the polish rate of the barrier film 105 and a metal membrane 107 uses the biggest possible slurry SL.

[0066] Furthermore, from a viewpoint which suppresses generating of dishing by the exaggerated polish, and erosion, output voltage of the electrolysis power supply 61 is made smaller than the above-mentioned process, and polish removal of the barrier film 105 is performed. Moreover, it is desirable to also make the processing pressure force of abrasive tools 3 smaller than the above-mentioned process. moreover, the monitor of the electrolytic current by the above-mentioned ammeter 62 if making small output voltage of the electrolysis power supply 61 and the barrier film 105 are removed, since the layer insulation film 102 will be exposed to a front face and the value of an electrolytic current becomes small -- replacing with -- the above-mentioned ohm-meter 63 -- a scrub -- it acts as the monitor of the electric resistance between a member 24 and abrasive tools 3

[0067] Removal of the barrier film 105 exposes the layer insulation film 102 on a front face, as shown in drawing 23 (process P10). since there are no metal membrane 107 and barrier film 105 for energizing on a front face as an anode plate in a part for this outcrop as shown in drawing 23 , when the layer insulation film 102 is exposed -- a scrub -- energization by the member 24 is intercepted and the electrolytic action for the outcrop of the layer insulation film 102 stops At this time, the electric resistance value which acted as the monitor with the ohm-meter 63 begins to increase.

[0068] Here, like the case of level difference relief of the heights of the above-mentioned metal membrane 107, instead of the passive-state film 108, concentration of the current density to the residual portion of a metal membrane 107 starts the barrier film 105 as a portion with high electric resistance, and elution removal of the residual portion of a metal membrane 107 is alternatively carried out between parts for the portion into which a metal membrane 107 remains, and the outcrop of the barrier film 105. Into the portion which the electrolytic action stopped, only the mechanical material removal operation by abrasive tools 3 and Slurry SL works actively.

[0069] By the way, in the usual chemical machinery polish, the polish rate selection ratio to the barrier film 105 and the layer insulation film 102 of a metal membrane 107 tends to be enlarged as much as possible, and it is going to secure the dimensional accuracy of the upper surface of the layer insulation film 102 by using the rate difference as a margin. For this reason, dishing of a metal membrane 107 has composition which is not avoided. Moreover, although dishing can be lessened to some extent if a selection ratio is set up low, a dimensional accuracy is generated when removal of the barrier film 105 and a metal membrane 107 is not enough in order to be dependent on the homogeneity of the amount distribution of removal within a wafer side. For this reason, in order for the barrier film 105 and a metal membrane 107 to prevent the undershirt polish which is in the state which remained on the upper surface of the layer insulation film 102, the exaggerated polish for the ununiformity within a field of the amount of removal is needed, and aggravation of the erosion by this exaggerated polish is not avoided in essence. On the other hand, with this operation gestalt, if the homogeneity within a field of Wafer W is secured to some extent, high efficiency removal will be carried out because an electrolytic action works into the residual portion of the barrier film 105 which remains on the layer insulation film 102, or a metal membrane 107, and elution will stop from a part for the outcrop of the layer insulation film 102. For this reason, the dimensional accuracy of the layer insulation film 102 is secured automatically, and generating of dishing and erosion is suppressed.

[0070] While the barrier film 105 formed from material, such as Ta, TaN, Ti, and TiN, as mentioned above is completely removable, generating of dishing by the exaggerated polish and erosion can be suppressed. Moreover, although current value is low and removal speed becomes slow by setting up a mechanical load lightly absolutely in the removal process of the barrier film 105 mentioned above If there are few metal membranes 107 which the thickness which remains becomes from the copper film of the residue of an uneven portion The barrier film 105 is made few to the grade which can disregard the absolute value of dishing and erosion though the amount of removal of the barrier film 105 itself is small since it is thin compared with a metal membrane 107, and there are variation and an ununiformity in this process, and can also shorten the processing time. Furthermore, since the polish method concerning this operation gestalt is compound processing to which the

electrochemical operation was added in addition to mechanical polish, also mechanically, as for the front face which carried out flattening, a damage can acquire a smooth field few.

[0071] Subsequently, when maximum, i.e., wiring formation, is completed by the electric resistance value based on the electric resistance value which acted as the monitor with the ohm-meter 63, the process which removes the barrier film 105 is ended (process PR 11). A controller 55 judges the value of an electric resistance value, and stops processing operation of polish equipment 1. In addition, by not contacting abrasive tools 3 on the front face of Wafer W, for example, passing about 100 micrometers of tops in the state [having added the electrolytic action], before ending polish processing, mechanical polish cannot be performed but the front face of the damage free-lancer only by the electrolytic action can be formed. Thereby, as shown in drawing 23 , finally into the layer insulation film 102, wiring 109 and contact 110 are formed.

[0072] Subsequently, Flushing is performed to the semiconductor device with which wiring 109 and contact 110 were formed (process PR 12). Supplying washing lotion liquid and an antioxidant to the front face of Wafer W immediately, after wiring 109 and contact 110 are formed, as it does not energize to Wafer W but is shown in drawing 24 , this Flushing process impresses the pulse voltage of plus to abrasive tools 3, performs pure water washing and medical fluid washing, and removes Slurry SL and the particle which exist in the front face of Wafer W. Since it is contained in Slurry SL, for example, you are making it just charged with this operation gestalt before performing Flushing in order that the polish abrasive grain PT which consists of an alumina may improve dispersibility, When it remains without wearing out after colliding with metal membrane 107 front face which consists of copper mechanically and contributing to removal processing, as it is not buried in the front face of the copper which constitutes the metal membrane 107 as an anode plate and was shown in drawing 23 , the reattachment is carried out to the front face of the abrasive tools 3 as cathode, and it contributes to the next processing. Furthermore, since the just charged particle can also be drawn near to the front face of the abrasive tools 3 as cathode, it is not buried on the surface of copper. The particle which remained on the front face of Wafer W and has been charged in negative on the other hand is also removable from the front face of Wafer W with above-mentioned Flushing. Moreover, when the polish abrasive grain PT uses the slurry SL charged in negative, it can remove similarly. Although it is necessary to remove a metal ion and PAIKURU, without being easy to oxidize and deteriorating a copper front face when wiring formation material is copper, with this operation gestalt, the polish abrasive grain PT is just electrified beforehand, and this problem is solved by Flushing. In addition, as a polish abrasive grain, although the aluminum oxide (alumina) was mentioned as an example, when a cerium oxide, a silica, a germanium dioxide, etc. are used, it is the same.

[0073] As mentioned above, according to the manufacture method of the semiconductor device concerning this operation gestalt, the passive state film 108 is formed in the metal membrane 107 which embeds the slot wiring for wiring and the contact hole which were formed in the insulator layer 102. The passive state film 108 formed in the heights of a metal membrane 107 is removed alternatively. Compared with the usual CMP, flattening of the initial irregularity can be far carried out to high efficiency by electrolytic polishing removing alternatively the metal membrane 107 exposed to the front face by using the remaining passive state film 108 as a mask, and removing intensively by concentration to current density. Moreover, since the metal membrane 107 to which flattening of the initial irregularity was carried out is removed by the electrolysis compound polish which electrolytic polishing and chemical machinery polish compounded, it can remove the excessive metal membrane 107 in high efficiency far compared with the usual CMP. For this reason, even if it sets up the processing pressure force of abrasive tools 3 low, while sufficient polish rate is obtained and being able to mitigate the damage to a metal membrane 107, generating of dishing or erosion can be suppressed.

[0074] Moreover, when according to the manufacture method of the semiconductor device concerning this operation gestalt the excessive metal membrane 107 is removed and the barrier film 105 is exposed In order to stop polish, to change Slurry SL into what has a high polish rate to the barrier film 105, to change polish conditions, such as output voltage of the electrolysis power supply 61, and to remove the excessive barrier film 105, The excessive barrier film 105 is certainly removable, and when an exaggerated polish is required, the yield of dishing or erosion can be stopped small.

[0075] Moreover, in order to grind a metal membrane in high efficiency by electrolysis compound polish according to the manufacture method of the semiconductor device concerning this operation gestalt, Since the processing pressure force of abrasive tools 3 can be made into the low voltage force, for example In order to reduce a dielectric constant from viewpoints, such as low-power-izing and improvement in the speed, when a mechanical strength uses a low organic system low dielectric constant film and a porosity low dielectric constant insulator layer comparatively as a layer insulation film 102, the damage to these insulator layers can be reduced.

[0076] The absolute value of the amount of polish processings of a metal membrane is controllable by time to pass the amount of addition of an electrolytic current, and the wafer W of abrasive tools 3 with the operation gestalt mentioned above. With the operation gestalt mentioned above, although the case of the wiring formation process by copper was explained, this invention can be applied to various metal wiring formation processes, such as a tungsten, aluminum, and silver, without being limited to this.

[0077] Moreover, although the operation gestalt mentioned above explained the case of the electrolysis compound polish which compounded the chemical machinery polish which used Slurry SL, and electrolytic polishing using the electrolytic solution EL, this invention is not limited to this. That is, this invention can also perform electrolysis compound polish by electrolytic polishing of the electrolytic solution EL, and mechanical polishing by polished surface 3a of abrasive tools 3, without using Slurry SL.

[0078] Moreover, although the polish process until it acts as the monitor of the current value which flows between abrasive tools 3 and the electrode boards 23 and the barrier film 105 is exposed based on this value was managed with the operation gestalt mentioned above, it is also possible to manage all polish processes by the current value which acted as the monitor. Although similarly it acted as the monitor of the electric resistance value between abrasive tools 3 and the electrode board 23 and being considered as the composition which manages only the removal process of the barrier film 105 with the operation gestalt mentioned above based on this value, it is also possible to manage all polish processes with the electric resistance value which acted as the monitor.

[0079] Modification 1 drawing 26 is the schematic diagram showing the example of a changed completely type of the polish equipment concerning this invention. the polish equipment 1 concerning the operation gestalt mentioned above -- the energization to a wafer W front face -- conductive abrasive tools and a scrub -- the energization board 23 equipped with the member 24 performed As shown in drawing 26 , the wheel-like abrasive tools 401 are good also as composition which also gives conductivity to the wafer table 402 which carries out chucking of the wafer W and is made to rotate it while they give conductivity as well as the case of polish equipment 1. Electric supply to abrasive tools 401 is performed with the same composition as the operation gestalt mentioned above. In this case, the energization to the wafer table 402 can form a rotary joint 403 in the lower part of the wafer table 402, and an electrolytic current can be supplied by considering energization to the wafer table 402 which rotates by the rotary joint 403 as the always maintained composition.

[0080] Modification 2 drawing 27 is the schematic diagram showing other modifications of the polish equipment concerning this invention. Chucking of the wafer W is carried out and the wafer table 502 to rotate is held by the retainer ring 504 which formed Wafer W in the circumference of Wafer W. While giving conductivity, conductivity is also given to a retainer ring 504 and electric power is supplied to abrasive tools 501 with the same composition as the operation gestalt mentioned above at abrasive tools 501. Moreover, a retainer ring 504 is covered and energized to the part for the above-mentioned barrier layer formed in Wafer W. Furthermore, electric power is supplied to a retainer ring 504 through the rotary joint 503 prepared in the lower part of the wafer table 502. In addition, even if abrasive tools 501 contact Wafer W, interference with abrasive tools 501 and a retainer ring 504 can be prevented by enlarging the amount of inclinations of abrasive tools 3 so that the crevice more than the thickness of a retainer ring 504 can be maintained in the portion of an edge.

[0081] Modification 3 drawing 28 is the outline block diagram showing other operation gestalten of the polish equipment concerning this invention. The polish equipment shown in drawing 28 is polish equipment which adds the electrolytic-polishing function of this invention to the CMP equipment of a conventional type, is contacted, rotating the whole surface of the wafer W in which chucking was carried out to the polished surface of the abrasive tools by which the polish pad (abrasive cloth) 202 was stuck on the surface plate 201 by the wafer chuck 207, and carries out flattening of the front face of Wafer W. The anode plate electrode 204 and the cathode electrode 203 are arranged by turns at the radial at the polish pad 202. Moreover, the anode plate electrode 204 and the cathode electrode 203 are electrically insulated by the insulator 206, and the anode plate electrode 204 and the cathode electrode 203 are energized from a surface plate 201 side. The polish pad 202 is constituted by these anode plate electrode 204, the cathode electrode 203, and the insulator 206. Moreover, the wafer chuck 207 is formed from the insulating material. Furthermore, the feed zone 208 which supplies the electrolytic solution EL and Slurry SL ~~is formed~~ in the front face of the polish pad 202 at this polish equipment, and the electrolysis compound polish which compounded electrolytic polishing and chemical machinery polish is attained.
[0082] Here, drawing 29 is drawing for explaining electrolysis compound polish operation by the polish equipment of the above-mentioned composition. In addition, the copper film 210 shall be formed in a wafer W front face. During electrolysis compound polish, as shown in drawing 29 , after the electrolytic solution EL and Slurry SL have intervened between the copper film 210 formed in the wafer W front face, and the polished surface of the polish pad 202, direct current voltage is impressed between the anode plate electrode 204 and the cathode electrode 203, Current i is transmitted to the inside of a copper film 210 through the electrolytic solution EL from the anode plate electrode 204, and it flows to the cathode electrode 203 through the electrolytic solution EL again. Near [in the circle G shown in drawing 29 at this time], while a copper film 210 is eluted by the electrolytic action, a copper film 210 is further removed by the mechanical removal operation by the polish pad 202 and Slurry SL.
[0083] By considering as such composition, the same effect as the polish equipment 1 concerning the operation gestalt mentioned above is done so. In addition, arrangement of the anode plate electrode prepared in a polish pad and a cathode electrode is good also as a polish pad 221 with which two or more linear anode plate electrodes 222 were arranged at equal intervals in all directions, the cathode electrode 223 has been arranged to each rectangle field surrounded by the anode plate electrode 222, and the anode plate electrode 222 and the cathode electrode 223 were electrically insulated with the insulator 224, as it is not necessarily limited to the composition of drawing 28 , for example, is shown in drawing 30 . Furthermore, it is good also as a polish pad 241 with which the annular anode plate electrode 242 from which a radius differs, respectively has been arranged on this heart, the cathode electrode 243 has been arranged to the annular region formed between each anode plate electrode 242, respectively, and the anode plate electrode 242 and the cathode electrode 243 were electrically insulated with the insulator 244, for example as shown in drawing 31 .
[0084]
[Effect of the Invention] According to this invention, since a metal membrane is ground by compound operation with mechanical polishing and electrolytic polishing, compared with the case of flattening of the metal membrane by mechanical polishing, alternative removal and flattening of the heights of a metal membrane become possible very much at high efficiency. Moreover, according to this invention, since abrasive tools are energized as cathode, the polish abrasive grain in the particle just charged beforehand or an abrasive material can draw near to abrasive tools, can prevent remaining to a wafer front face, and can aim at improvement in the yield. Moreover, according to this invention, since it becomes high efficiency removable [a metal membrane], it can suppress that polish rate comparatively sufficient also by the low polishing pressure force is obtained, and a scratch, dishing, erosion, etc. occur in the ground metal membrane. Furthermore, in order to obtain polish rate comparatively sufficient also by the low polishing pressure force, to accumulate and to reduce a dielectric constant from viewpoints, such as low-power-izing of a semiconductor device, and improvement in the speed, when a mechanical strength uses a low organic system low dielectric constant film and a porosity low dielectric constant insulator layer comparatively as a layer insulation film according to this invention, it can apply easily. Moreover, according to this invention, since it is efficiently removed because an electrolytic action works, and elution stops from a part for the outcrop of an insulator layer, the portion of the barrier film which remains on a layer insulation film, or a metal can secure the stopping accuracy of polish automatically, and can suppress dishing and erosion. Moreover, according to this invention, a polish process can be managed by carrying out the monitoring of the electrolytic current, and it becomes possible to grasp the advance state of a polish process correctly. Moreover, according to this invention, by carrying out the monitoring of the electric resistance value between abrasive tools and polar-zone material, current cannot flow easily, or even when grinding simultaneously the film and metal membrane to which current does not flow, a polish process can be managed correctly.

[Translation done.]